Chief, R&D Branch

1 July 1959

Chief, R&D Laboratory

[redacted] Study 50X1

1. Experience and knowledge gained in the successful design of the [redacted] suggests the possibility of designing an [redacted] keyer with similar type magnetic core circuitry. This type [redacted] would have advantages over present [redacted] using other types of message storage and readout. This report outlines several of these advantages and indicates some of the considerations involved in the design of a magnetic core [redacted] 50X1 50X1 50X1 50X1

2. The types of [redacted] devices in present use require some mechanical motion between the storing medium and the reading and writing mechanism. This generally takes the form of a magnetic drum, magnetic tape, punched tape, marked tape, etc.; all requiring a mechanical spring or electric motor to transport the storage medium when reading or writing. In the proposed [redacted], functions of storage, gating, and switching will be done by magnetic cores. A magnetic core system offers the following advantages over most existing systems. 50X1 50X1

(a) Very low power when operated at the speeds encountered in communication systems.

(b) Smaller size.

(c) No resupply of the storing medium required, as in a tape system.

(d) No practical limitation on maximum or minimum speed.

(e) Good speed regulation. This should be in the order of less than 4 percent error in the "bit" duration and spacing.

(f) The equipment could be designed to operate as an on-line or off-line keyer.

3. A study was made to determine some of the salient features of an [redacted] using ferrite apertured plates in a "bit" memory arrangement. These plates have a 16 x 16 structure providing a total of 256 cores. Forty-five of these plates can be arranged to provide a switch and storage of 600 characters, or a 100 group message. The 600 characters may be scanned through a 24 by 25 stage 50X1

shift register to provide access to the store. Assembly of this arrangement should be relatively easy since, in addition to the printed wire already on the plates, only one wire is required through each hole in each of three stacks of ten plates in the memory. The switch plane will require one wire in both the X and Y planes through each hole in each of three stacks of five plates. One wire through each hole in the switch Z plane will interconnect the switch and memory. The characters are placed in the memory in parallel by a 32-character keyboard through a 10-core input matrix. The signals read out from the memory will set the proper cores in an output matrix which will in turn be read out in series by a shift register to provide baudot code. The circuitry for synthesizing the actual code characters, for example, Barker code, will be quite similar to the [redacted] The only difference is that the input to the keyer will be from a memory store instead of from buttons on a keyboard. 50X1

4. The following comments outline some of the features of [redacted] and provide some idea of the circuit development required. 50X1

(a) Features:

(1) [redacted] will be made to have non-destructive readout. In other words, the information may be read back into the memory store immediately after the character has been set into the output matrix and read out, making it possible to transmit the same message as many times as it is desired. Or, of course, the message may be read out and destroyed from the memory in preparation for another message, if this is desired. 50X1

(2) It is possible with [redacted] of this type to read the memory at different speeds, depending upon the application. The limitation here would be the upper frequency limit of the unijunction transistor and the power requirements of the cores. Both of these limits should be well above any practical communication speed of transmission. An example of the power requirement for a core matrix indicates that a typical 50 x 50 matrix switched at a 1 mc rate requires 1 kw compared to 0.1 watt at a 50 cps rate. 50X1

(3) A 100-group 32-character storage keyer would require approximately 28 cubic inches of volume. The actual ferrite memory store would require only about 4 cubic inches of volume. The shift register, keyboard, and gate circuits take up most of the volume.

(4) The power required for the storage unit and the read-in and read-out circuits is estimated to be of the order of 500 mw. Since most of the power is required by the read-in and read-out circuits, it is practically independent of storage capacity.

(5) [redacted] may be readily adapted to provide parallel output for QFM-type transmission. 50X1

(b) Circuit Development:

It will be necessary to develop circuitry for the following functions.

(1) A shift register capable of supplying the required pulses to read and write into the memory plates.

(2) Switch-core gate circuitry to select the memory line and to provide pulse regeneration for non-destructive read-out.

(3) A pulse amplifier to amplify the pulses from the memory to a useful level.

(4) [redacted] type code synthesizer will be necessary. 50X1
[redacted] may be used but some simplification may 50X1
be made on this circuit to reduce the components required. Some work should also be done here to determine the lowest power required in a flip-flop circuit.

5. The component cost of a 100-group 32-character off-line keyer is estimated to be approximately $1500 per unit.

6. A breakdown of the circuitry proposed on the basis of this study is attached. Time estimates are included to cover engineering, fabrication, and testing through the prototype stage. We propose to assign three engineers to the project full time with engineering aid support as required. On the basis of these estimates and assignments a target date of nine months from 1 July 1959 is considered reasonable.

[redacted] 50X1

Attachment: Time Estimates

Lab/JCT/rkb (1 July 1959) Dist.: Orig. & 1 - Addressee 1 - Lab Subj 1 - Dev/s 1 - R&D Chrono

50X1

[redacted] - TIME ESTIMATES

	ENGINEERING			FABRICATION & TESTING	
CIRCUIT FUNCTION	Electrical	Mechanical	Drafting	Electrical	Mechanical
Pulse Amplifier	400	32	80	64	8
Keyboard	320	320	80	64	40
Shift Register	240	32	120	64	8
Memory Store	240	64	80	80	40
Barker Code Gen.	200	24	80	40	32
Gating Circuits	200	24	40	32	8
Switch Plate Drive	200	64	80	80	40
Serial Read-out	200	24	40	40	8
Recognition	160	24	24	24	8
DC Converters	80	24	8	24	8
Man/hours	2240	632	632	512	200
Man/weeks	56	16	16	13	5

42[redacted] man/hrs.

106 man/wks.